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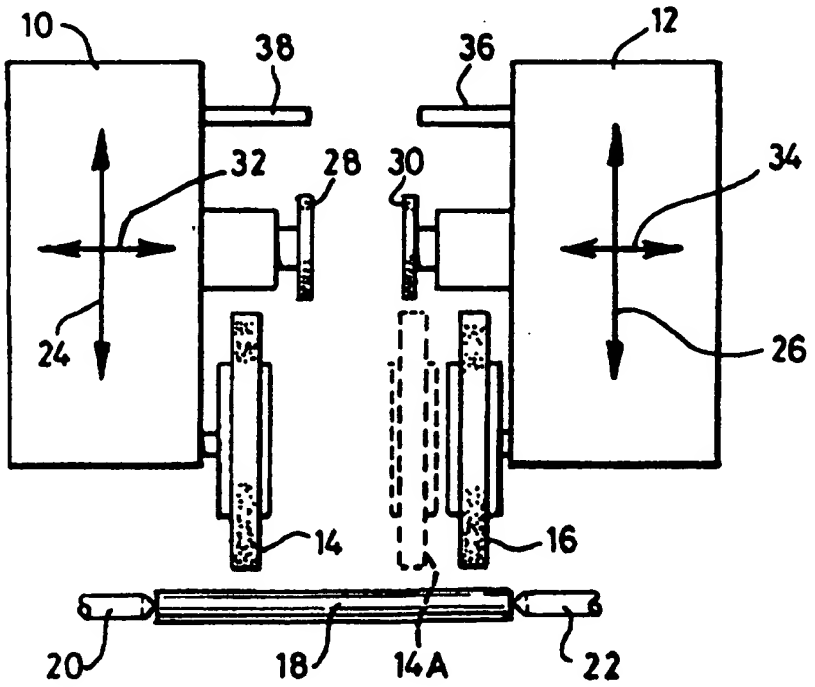
(54) Title: IMPROVEMENTS IN OR RELATING TO GRINDING MACHINES

(57) Abstract

The invention relates to a method and apparatus for dressing the grinding wheels of a dual head grinding machine. To this end a dual wheel head grinding machine is provided having first and second heads (10, 12) respectively carrying first and second grinding wheels (14, 16), wherein the first and second wheels heads respectively also carry first and second wheel dressers (28, 30) and the two wheel heads are relatively movable to enable the first dresser to dress the second grinding wheel, or to enable the second dresser to dress the first grinding wheel. The two wheel heads are preferably movable in two coordinate directions, firstly to enable movement towards and away from one another and secondly to enable infeed and reverse movement at right angles thereto.



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Title Improvements in or relating to Grinding Machines

Field of the invention

This invention relates generally to grinding machines, and in particular to a grinding machine having two wheel heads, each carrying a grinding wheel, thereby to enable two positions along a workpiece to be ground simultaneously, for example when grinding cams on an engine camshaft.

Background to the invention

Dual wheel grinding machines are well known. It is also well understood that when a grinding wheel is in use, it can develop deformations from circularity, of several possible types, requiring the wheel to be reshaped with a dressing tool or a truing tool. In this specification, the term "dresser" is employed to refer to either a dressing tool or a truing tool, and the term "dress" to refer to either dressing or truing.

In the case of a dual wheel grinding machine, the grinding wheels are not necessarily the same size. It has been considered not practical to incorporate facilities for dressing or truing in the machine because of the space and complexity of design required to carry a normal two axes dressing unit on each wheelhead. In a machine having only a single grinding wheel, a separate head can be incorporated, but this is obviously not readily possible in a machine already having two wheel heads. It is conventional practice to demount the grinding wheels for dressing or truing.

It is an object of the present invention to provide a

solution to the above-described problem.

The invention

According to one aspect of the invention, there is provided a dual wheel head grinding machine having first and second wheel heads respectively carrying first and second grinding wheels, wherein the first and second wheel heads respectively also carry first and second grinding wheel dressers and the two wheel heads are relatively movable to enable the first dresser to dress the second grinding wheel and to enable the second dresser to dress the first grinding wheel.

According to another aspect of the invention, there is provided a method of truing or dressing the grinding wheels of a dual wheel head grinding machine, according to which the two wheel heads, in addition to first and second grinding wheels, respectively carry first and second dressers, comprising the step of moving the first wheel head to cause the first dresser to dress the second grinding wheel and, or the step of moving the second wheel head to cause the second dresser to dress the first grinding wheel.

Preferably, the two wheel heads are each movable in two coordinate directions, firstly a lateral movement towards and away from one another and secondly a feed movement at right angles thereto. The lateral movement is preferably parallel to an axis through the first and second grinding wheels, which may be coaxial, and the feed movement is at right angles to said axis and enables the infeed/outfeed movement of the respective grinding wheel relative to the workpiece, as well as engagement of the respective dresser with a grinding wheel.

The first and second dressers on the two wheel heads are desirably not aligned, but both preferably lie in a plane normal to the axial plane through the axis of the grinding wheels containing the directions of movement of the wheel heads, but respectively on opposite sides of this axial plane. Registration of the dressers in this way, relative to the grinding wheels, enables the first dresser to move past the second dresser when the first dresser is employed to dress the second grinding wheel, and vice versa.

It is an obvious requirement, if the two dressers are mounted in fixed relationship to the respective wheel heads, for the two dressers to be positioned closer together than the two grinding wheels in the normal condition in which grinding takes place, each dresser preferably being spaced further from the wheel head which carries it than the grinding wheel carried by that wheel head.

Correct lateral positioning calibration is preferably achieved by means of a probe on one wheel head and an anvil on the other. Contact between them may signal a stop command to the drive producing the lateral movement. The feed movement which brings the first dresser into contact with the second grinding wheel, or the second dresser into contact with the first grinding wheel, is judged by touch contact in a conventional manner. The probe may be adjustable between two conditions if, as is preferred, the lateral movement for bringing the first dresser into alignment with the second grinding wheel is not the same as that for bringing the second dresser into alignment with the first grinding wheel.

Dressing may be effected by movement of one wheel head only.

Again, if the dressers are mounted in fixed relationship to the respective wheel heads, all lateral relative movement between the wheel heads for effecting dressing is preferably carried out by the wheel head carying the grinding wheel to be dressed, although this is not essential.

Mounting the dressers in fixed relationship to the wheel heads places limitations on the difference between the sizes of the grinding wheels which can be dressed, posssibly on the extent of non-axial alignment of the grinding wheels necessary for grinding different parts of a workpiece, and possibly also on the difference between the amounts of dressing of the respective grinding wheels which is practicable.

In a preferred machine, therefore, the dressers are mounted each to be laterally movable independently of the lateral movement of the wheel heads which carry the respective dressers. For example, the dressers may each be mounted on a slide which is itself mounted to be laterally slidable on a guide means carried by the corresponding wheel head.

This avoids any possible problem of fouling between the non-operative dresser and the second grinding wheel when the operative dresser is aligned with the first grinding wheel, and vice versa.

Description of embodiments

Embodiments of dual wheel head grinding machine are now described by way of example with reference to the accompanying drawings, in which:-

Figures 1, 2 and 3 respectively show a simple machine diagrammatically in plan, side, and rear views, for

enabling the principle of the invention to be understood;

Figure 4 is a diagrammatic plan view of a preferred machine in a typical condition for dual grinding of a workpiece;

Figure 5 is a corresponding view when the machine is in a typical condition for dressing one of the grinding wheels;

Figure 6 is a diagrammatic view of a dressing wheel slide assembly; and

Figure 7 shows a slide in perspective.

Referring to Figures 1 to 3, the illustrated grinding machine has two wheel heads 10, 12 respectively carrying grinding wheels 14, 16 in coaxial relationship for grinding two spaced positions along a workpiece 18 rotatable betwen a headstock 20 and a tailstock 22. A rotary drive for each grinding wheel 14, 16 is housed within the respective wheel head, and the infeed/outfeed movement of each grinding wheel is produced by a controlled feed movement of the respective wheel head, as indicated by the arrows 24, 26.

In addition to the grinding wheels 14, 16, the wheel heads 10, 12 respectively carry dressing or truing tools 28, 30, herein referred to as dressers. The dressers 28, 30, however, are not coaxial, but disposed on opposite sides of a vertical plane through the axis of the grinding wheels, as will be clear from Figures 2 and 3.

Each wheel head, in addition to its vertical feed movement, is laterally movable towards the other wheel head, as indicated by the arrows 32, 34.

Thus, as indicated in dashed line at 14A, it is possible

laterally to move grinding wheel 14 beneath dresser 30, or alternatively to move grinding wheel 16 laterally to position it beneath dresser 28. Correct lateral positioning is ensured by means of a probe 36 on the wheel head 12 and a corresponding anvil 38 on the wheel head 10.

Subsequently, by use of the available feed movement of one of the wheel heads 10, 12, the dresser 30 can be engaged with the grinding wheel 14 to effect dressing, or likewise for the grinding wheel 16 and dresser 28.

It will be noted that the two dressers 28, 30 pass one by the other during the lateral feed movement effected in readiness for dressing, and it is possible that each dresser may be vertically aligned with a grinding wheel at the end of this feed movement. However, simultaneous dressing of both grinding wheels is not possible because the respective distances between the centres of the respective pairs of grinding wheels and dressers will not be the same. Moreover, although not illustrated, the two dressers 28, 30 are preferably mounted at different distances from the sides of the wheel heads 10, 12 such that when one dresser 28 is truing grinding wheel 16, the other dresser 30 is laterally displaced from, i.e. non-aligned with, its grinding wheel 14. The sensing means 36, 38 may be adjustable to allow for the different lateral movements to be carried out when the respective pairs of grinding wheels and dressers are to be aligned. In addition to the impracticality of simultaneous dressing, the vertical feed movement of one dresser (or grinding wheel) necessary for dressing increases the separation of the other dresser and grinding wheel. On the other hand, it is not essential for the lateral movement required for dressing to be performed by the wheel head carrying the grinding wheel to be dressed, nor indeed for this relative lateral movement to be performed solely by one wheel head.

The dresser 30, 28 traverses across the face of the grinding wheel 14, 16 to dress, or true the wheel. The actual grinding and dressing or truing processes carried out by the machine are not herein described, because they are practised in a wholly conventional manner.

Notwithstanding Figures 1 to 3, it is to be understood that the invention is not limited to machines which have grinding wheels of equal diameter, nor to the requirement to dress the respective grinding wheels by equal amounts.

A preferred, more versatile machine is illustrated in Figures 4 to 7, wherein the same reference numerals as Figures 1 to 3 are employed for corresponding parts.

In the preferred machine, the dressers 28, 30 are mounted on respective slides 40, 42 which are themselves slidably mounted for lateral movement of the dressers on guides 44 (see Figure 7) housed within the respective wheel heads 10, 12. References 46, 48 denote driving means for the respective slides 40, 42.

In Figure 4, the machine is shown in the condition for conventional dual grinding of a workpiece by the spaced grinding wheels 14, 16. For grinding different parts of the workpiece, the grinding wheels 14, 16 are shown non-aligned axially. Moreover, although not shown, these grinding wheels could be of quite substantially different diameters. The axes of the dressers 28, 30 again lie in front of and behind the plane of the Figure 4 drawing, as is apparent from the plan view of a wheel head shown in Figure 6, in which reference 50 denotes the axis of the grinding wheel 14, typically a diamond wheel, and reference 52 denotes the axis of the dresser 28, typically a carbon-boron wheel.

Figure 5 shows the machine when in the condition for truing the grinding wheel 16 with the dresser 28. Slide 40 has been operated, in conjunction with a relative lateral movement of the wheel heads 14, 16, possibly to an extent controlled by a suitable sensing means (not shown), to bring dresser 28 into alignment with grinding wheel 16. Relative vertical movement of the two wheel heads 14, 16 is being carried out to effect truing.

Figure 6 also shows, in diagrammatic manner, one possible form of drive means 46, 48 contained within each wheel head 14, 16, for effecting movement of the slide. This drive means may be electrically or hydraulically powered, for example.

Claims

1. A method of truing or dressing the grinding wheels of a dual wheel head grinding machine, according to which the two wheel heads, in addition to first and second dressers, respectively carry first and second dressers, comprising the step of moving the first wheel head to cause the first dresser to dress the second grinding wheel.

2. A method of truing or dressing the grinding wheels of a dual wheel head grinding machine, according to which the two wheel heads, in addition to first and second dressers, respectively carry first and second dressers, comprising the step of moving the second wheel head to cause the second dresser to dress the first grinding wheel.

3. A dual wheel grinding machine having first and second wheel heads respectively carrying first and second grinding wheels, wherein the first and second wheel heads respectively also carry first and second grinding wheel dressers and the two wheel heads are relatively movable to enable the first dresser to dress the second grinding wheel and to enable the second dresser to dress the first grinding wheel.

4. A dual wheel grinding machine according to claim 3, wherein the two wheel heads are each movable in two coordinate directions, firstly a lateral movement towards and away from one another and secondly a feed movement at right angles thereto.

5. A dual wheel head grinding machine according to claim 4, wherein the lateral movement is parallel to an axis through the first and second grinding wheels and the feed

movement is at right angles to said axis and enables the infeed/outfeed movement of the respective grinding wheel relative to the workpiece as well as engagement of the respective dresser with a grinding wheel.

6. A dual wheel head grinding machine according to claim 5, wherein the axis through the first and second grinding wheels is coaxial.

7. A dual wheel head grinding machine according to any of claims 3 to 6, wherein the first and second dressers in the two wheel heads are not aligned but both lie in a plane normal to the axial plane through the axis of the grinding wheels containing the directions of movement of the wheel heads, and are respectively on opposite sides of this axial plane so as to enable the first dresser to move past the second dresser when the first dresser is employed to dress the second grinding wheel, and vice versa.

8. A dual wheel head grinding machine according to any of claims 3 to 7, wherein correct lateral positioning calibration is achieved by means of a probe on one wheel head and an anvil on the other wheel head.

9. A dual wheel head grinding machine according to claim 8, wherein the probe and anvil signals a stop command to the drive producing the lateral movement.

10. A dual wheel head grinding machine according to claim 8 or claim 9, wherein the probe is adjustable between two conditions when the lateral movement for bringing the first dresser into alignment with the second grinding wheel is not the same as that for bringing the second dresser into alignment with the first grinding wheel.

11. A dual wheel head grinding machine according to any of

claims 3 to 10, wherein dressing is effected by movement of one wheel head only.

12. A dual wheel head grinding machine according to any of claims 3 to 11, having the dressers mounted in fixed relationship to the respective wheel heads, wherein all lateral relative movement between the wheel heads for effecting dressing is carried out by the wheel head carrying the grinding wheel to be dressed.

13. A dual wheel head grinding machine according to any of claims 3 to 12, wherein the dressers are mounted each to be laterally movable independently of the lateral movement of wheel heads which carry the respective dressers.

14. A dual wheel head grinding machine substantially as herein described with reference to and as illustrated in the accompanying drawings.

15. Method of dressing grinding wheel in a dual head grinding machine substantially as herein described with reference to and as illustrated in the accompanying drawings.

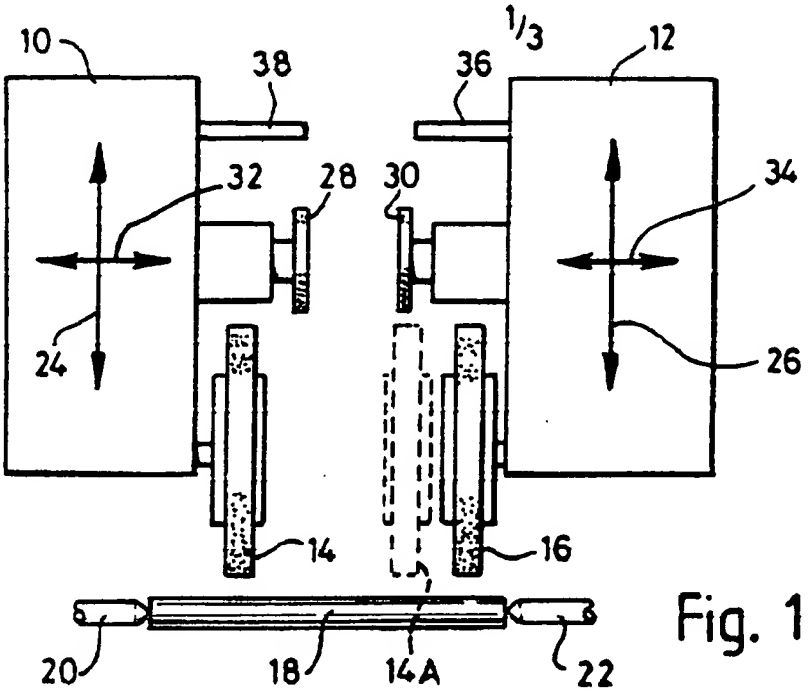


Fig. 1

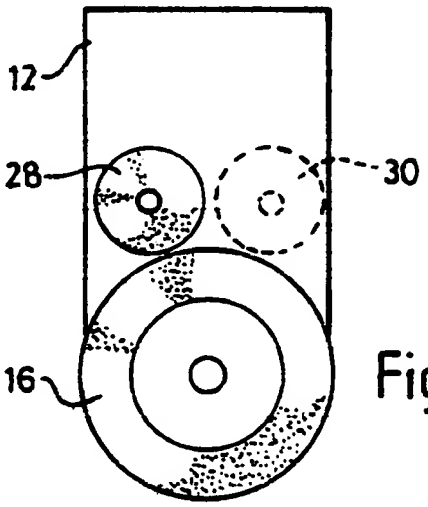


Fig. 2

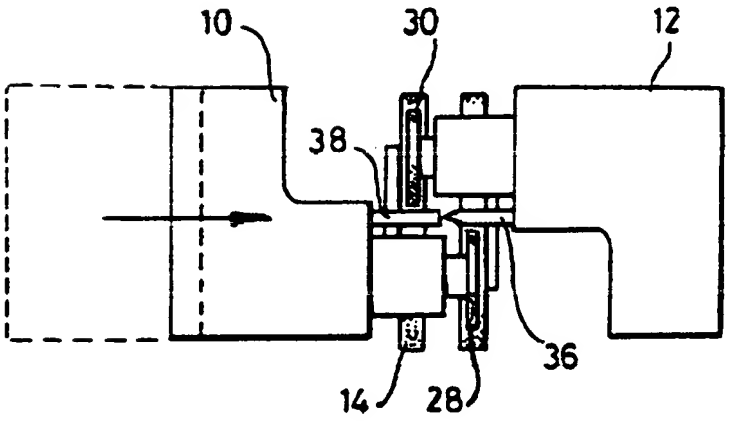


Fig. 3

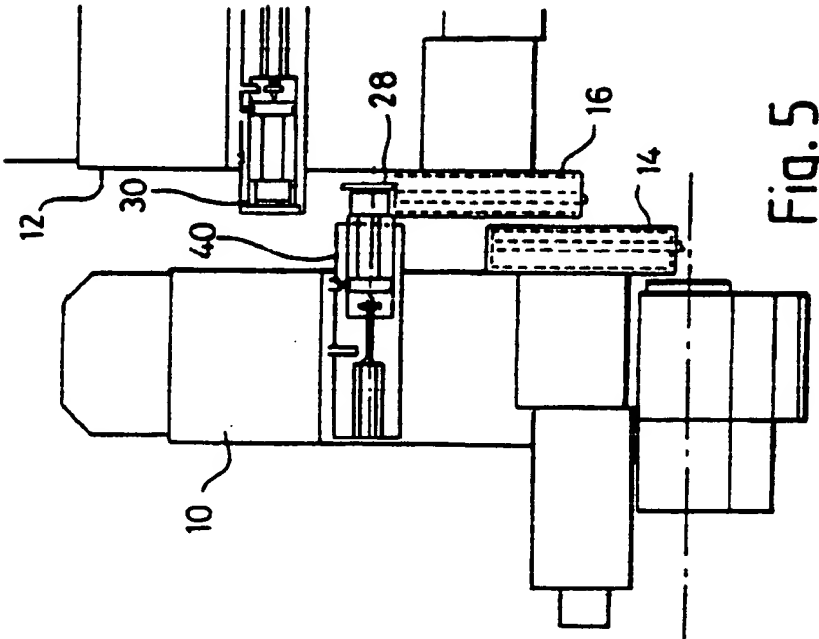


Fig. 5

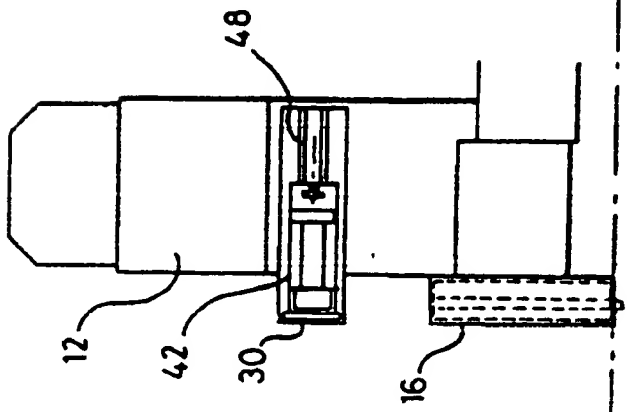
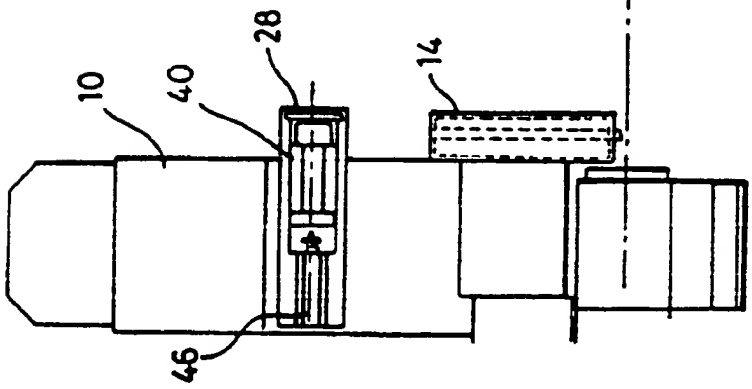


Fig. 4



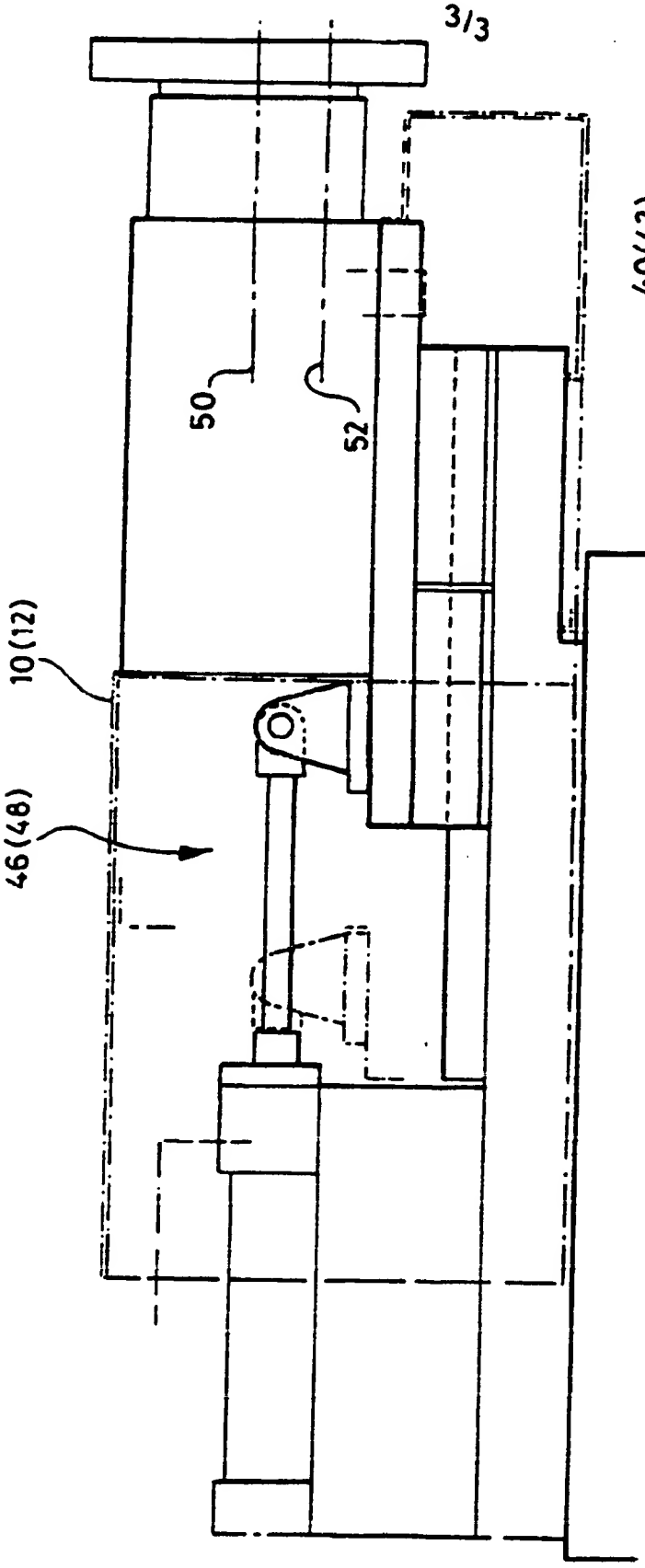


Fig. 6

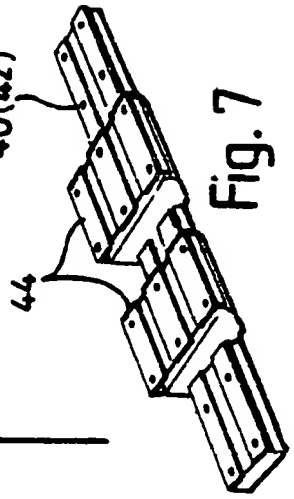


Fig. 7

INTERNATIONAL SEARCH REPORT

Later nal Application No
PCT/GB 95/01446

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B24B53/053 B24B19/12

According to ... rnational Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO,A,86 03706 (UVA AB) 3 July 1986 see page 7, line 22 - page 8, line 11; figures	1-6, 11-13
Y	CH,A,339 530 (THE GLEASON WORKS) 31 August 1959 see page 3, line 83 - line 114	1-6, 11-13
A	EP,A,0 505 836 (TOYODA MACHINE WORKS LTD) 30 September 1992 see column 4, line 19 - line 40	1,8-10
A	US,A,4 530 187 (KOIDE TSUYOSHI ET AL) 23 July 1985 see abstract	1

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☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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